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The remedy is separation into—

Ashes, to be used as filling or dumped.

Trash, to be used as filling or dumped.

Manure, to be carted to farms or dumped.

Garbage, to be fed to hogs, collection being made by the city through its own agencies.

Table of percentages of conditions in the less sanitary districts.

Locality.	Using city water.	Using wells.	Using cisterns.	Having sewer connections.	Disposal of—	
					Garbage and manure.	Trash.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
St. Joseph proper	90	3	7	40	70	75
South St. Joseph	55	35	1	1	47	57
Skeeterville, Florence, and Hyde Park	48	27	1	....	48	52

Night soil is very well disposed of if it must exist, but should be eliminated entirely by a complete connection of premises and sewers.

ROCKY MOUNTAIN SPOTTED FEVER.

SOME INVESTIGATIONS MADE DURING 1912 BY PASSED ASST. SURG. T. B. McCLINTIC.

Prepared for publication by L. D. Fricks, Surgeon, United States Public Health Service.

During the summer of 1912, from April 11 to July 30, Passed Asst. Surg. T. B. McClintic carried on his second series of investigations of Rocky Mountain spotted fever in the Bitter Root Valley at Victor, Mont.

Early in August, just at the close of a successful season's work, Dr. McClintic himself contracted the disease in the Bitter Root Valley and died August 13 at Washington, D. C. He was thus denied the satisfaction of reporting the valuable observations made by him during his last season's work, which included (*a*) the first systematic determination of the percentage of infective ticks from different localities in the Bitter Root Valley, (*b*) the discovery of immune and, therefore, presumably previously infected ground squirrels (*Citellus columbianus*) in nature, (*c*) studies on the susceptibility of the woodchuck (*Marmota flaviventer*), the rock squirrel (*Callo-spermophilus lateralis cinerascens*), and the mountain goat (*Oreamnos montanus*) to Rocky Mountain spotted fever, and (*d*) studies on the efficiency of different dipping solutions used for the destruction of adult ticks on live stock.

Because of the importance of these observations in the further study of Rocky Mountain spotted fever it has been deemed advisable to carefully review Dr. McClintic's notes of his work during the season of 1912 and prepare them for publication and future preservation. While the notes were found quite complete up to the last week in July, they recorded only the bare experiments conducted; and in order that these may be better understood, explanations of the methods of procedure and a summary of the results obtained are here included with Dr. McClintic's work. Nothing further than this will be attempted.

Infective Ticks in Nature.

Infective ticks in nature have been reported by Ricketts[1] in 1902—one tick out of 293 experimented with—and by Maver[2] in 1911—two ticks out of 402. The exact source of these ticks was not definitely given by the experimenters, but the majority of them, if not all, were collected somewhere in the Lo Lo Valley.

In 1912 McClintic collected nearly 2,000 ticks from different localities in the Bitter Root Valley and from Bannock County, Idaho. These ticks were used in his experiments by being placed in groups on susceptible guinea pigs, and there allowed to feed until completely engorged, whenever they would do so. Of the total number of ticks collected, 1,570 were actually employed in these experiments and 1,282 were known to have fed a sufficient length of time to infect their hosts; 288 ticks either made no attempt to feed or were destroyed by the guinea pigs before their attachment was noted.

Except where noted, the ticks from the Bitter Root Valley were unfed *Dermacentor andersoni* (Stiles) collected from the grass and bushes in the localities named and those from Idaho were *Dermacentor modestus* (Banks).

The ticks were collected from 14 different localities and arranged in 55 groups which varied greatly in the number of ticks they contained. The irregular grouping was a matter of convenience or necessity occasioned by the interrupted manner in which the ticks were collected.

The grouping of ticks adopted in these and similar experiments is a matter of economy in time, labor and guinea pigs employed, made necessary by the very small percentage of infective ticks found in nature by this method. The experiments, therefore, are not conclusive as to the exact number of infective ticks, since there may have been more than one such tick in the groups reported positive. This seems quite probable in the case of the ticks collected from goat No. 5.

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[1] J. A. M. A., 1907, vol. 49, p. 24.

[2] J. Infec. Diseases, 1911, vol. 8, p. 327.

The experiments noted by Dr. McClintic are shown in the following table, in which F. indicates female, M. male, + positive, and – negative:

	Date.	Number ticks employed.	Number ticks attached.	Where collected.	Result.	Remarks.
	1912.					
G. P. 400	Apr. 11	24; 13 F., 11 M.	23	Bear Creek	–	G. P. 400 died of peritonitis Apr. 20.
G. P. 401	Apr. 13	31; 16 F., 15 M.	26	Bates, Payne, and Williams ranches.	–	
G. P. 407	Apr. 16	40; 19 F., 21 M.	30	Payne and Williams ranches.	–	
G. P. 408	...do	15; 5 F., 10 M.	10	Goat No. 1	(?)	Mountain goat killed at head of Bear Creek Apr. 13.
G. P. 409	Apr. 17	5	3	...do	–	*Dermacentor albipictus.*
G. P. 410	...do	16; 12 F., 4 M.	11	...do	–	
G. P. 412	Apr. 21	21; 4 F., 17 M.	15	...do	–	Do.
G. P. 413	...do	13; 4 F., 9 M.	7	...do	–	
G. P. 414	...do	6; 3 F., 3 M.	6	...do	–	Do.
G. P. 415	...do	41; 25 F., 16 M.	35	Payne and Williams ranches.	+	
G. P. 416	...do	16; 12 F., 4 M.	9	Bear Creek	–	
G. P. 421	Apr. 26	10; 6 F., 4 M.	7	Goat No. 1	–	4 F. albipictus, 3 andersoni attached.
G. P. 422	...do	35; 24 F., 11 M.	29	Bear Creek	–	
G. P. 423	Apr. 30	26; 16 F., 10 M.	25	Gash Creek	–	
G. P. 425	May 3	32; 20 F., 12 M.	30	Mixed ticks, Bear Creek to Sweathouse.	+	
G. P. 427	May 5	67; 38 F., 29 M.	62	Gash Creek and Sweathouse.	–	
G. P. 445	May 10	60; 23 F., 17 M.	40	School section, Florence.	–	
G. P. 446	...do	19; 10 F., 9 M.	19	...do	–	
G. P. 447	...do	10; 5 F., 5 M.	10	...do	–	
G. P. 448	...do	23; 13 F., 10 M.	12	West of Hamilton	–	
G. P. 463	May 13	15; 8 F., 7 M.	14	West of Stevensville	–	
G. P. 464	...do	26; 16 F., 10 M.	20	Bear Creek	+	
G. P. 466	May 15	22; 8 F., 14 M.	22	Bass Ranch, west of Stevensville.	–	
G. P. 467	May 16	54; 25 F., 29 M.	39	School section, Florence.	–	
G. P. 485	May 18	27; 11 F., 16 M.	23	From a brown bear caught west of Victor.	–	
G. P. 486	...do	16; 9 F., 7 M.	13	Stock on Eddy Ranch, Victor.	–	
G. P. 487	...do	35; 21 F., 14 M.	29	Gash Creek	–	
G. P. 488	May 19	89; 50 F., 39 M.	72	East side of valley	–	
G. P. 538	May 25	35; 21 F., 14 M.	34	West of Darby	–	
G. P. 539	...do	30; 11 F., 19 M.	26	...do	–	
G. P. 541	May 27	10; 8 F., 2 M.	10	West of Hamilton, between Blodgett and Canyon Creek.	–	
G. P. 542	May 28	29	20	From a brown bear caught west of Victor.	–	
G. P. 545	May 30	11; 5 F., 6 M.	11	West of Florence vat	–	
G. P. 546	...do	20; 14 F., 6 M.	19	...do	–	
G. P. 555	June 1	12; 6 F., 6 M.	11	Goat No. 2	–	Mountain goat killed at head of Sweathouse Canyon May 30; 422 ticks collected from goat.
G. P. 556	...do	24; 12 F., 12 M.	19	Goat No. 3	–	Mountain goat killed at head of Sweathouse Canyon May 30; 158 ticks collected.
G. P. 557	...do	12; 4 F., 8 M.	10	...do	–	Do.
G. P. 582	June 5	22; 15 F., 6 M.	8	Goat No. 4	–	Mountain goat killed at head of Bear Creek May 30.
G. P. 583	...do	29; 11 F., 18 M.	26	Goat No. 5	(?)	Mountain goat killed on Bear Creek June 3; 337 ticks collected from goat.
G. P. 584	...do	30; 11 F., 19 M.	26	Goat No. 6	–	Mountain goat killed on Bear Creek June 3; 197 ticks collected.

	Date.	Number ticks employed.	Number ticks attached.	Where collected.	Result.	Remarks.
	1912.					
G. P. 585	June 5	38; 9 F., 29 M.	38	Ten-Mile Springs, Idaho.	–	
G. P. 586	...do	33; 17 F., 16 M.	26	.....do	–	
G. P. 587	...do	26; 14 F., 12 M.	15	Soda Springs, Idaho	–	
G. P. 590	June 8	48; 24 F., 24 M.	40	Goat No. 2	–	
G. P. 593	June 9	42; 12 F., 30 M.	35	Goat No. 3	–	
G. P. 595	...do	60; 30 F., 30 M.	54	Goat No. 6	–	
G. P. 600	June 12	25; 15 F., 10	18	Ten-Mile Springs, Idaho.	–	
G. P. 601	June 13	30; 24 F., 6 M.	27	.....do	–	
G. P. 602	...do	25; 20 F., 5 M.	22	West of vat, Florence	–	
G. P. 603	...do	39; 21 F., 18 M.	35	Goat No. 2	–	
G. P. 604	June 15	26; 16 F., 10 M.	25	.....do	–	
G. P. 605	...do	31; 17 F., 14 M.	14	Goat No. 5	+	
G. P. 606	...do	46; 33 F., 14 M.	36	Goat No. 6	(?)	
G. P. 608	June 21	25; 15 F., 10 M.	24	Goat No. 5	+	
G. P. 609	...do	27; 16 F., 11 M.	27	.....do	+	

The final test of all negative guinea pigs was the inoculation, intraperitoneally, of 0.5 cubic centimeter heart blood from an infected spotted-fever pig, designated in these experiments as "old virus," "virus T," "virus G," according to the strain employed, within two weeks of the time the ticks were removed. In the case of positive pigs, transfers of heart blood were made to other guinea pigs and spotted fever was reproduced in them.

Of the localities from which the ticks used in these experiments were collected, the following are in the foothills west of Victor: Bear Creek Canyon, Bates, Payne and Williams Ranches, Gash Creek Canyon, and Sweathouse Canyon.

Mountain goats Nos. 5 and 6 were noted as having been killed at the same place halfway up Bear Creek Canyon, while goats Nos. 1 and 4 were killed farther back at the head of the same canyon. This is probably an insignificant fact, since the goats range in small bands over great distances around the head of the different canyons.

In the case of guinea pig No. 408, on which 15 ticks from goat No. 1 were placed April 16, the result was given as doubtful because the pig never ran a temperature; but the usual immunity test of 0.5 cubic centimeter spotted-fever virus "T," given May 6, and in addition 0.5 cubic centimeter spotted-fever virus "old," given May 15, both failed to infect the pig. We can only conclude that pig No. 408 had a natural immunity to spotted fever, which is extremely improbable, that it received a very mild infection with immunization from the ticks, or that it was immunized without being infected by the ticks. Among the thousands of guinea pigs experimented with, no pig naturally immune to spotted fever has been recorded.

With guinea pig 583, on which 29 ticks from goat No. 5 were placed June 5 the result was the same as that in pig No. 408. There was no clinical evidence of spotted fever following the tick bites, nor was this pig's blood infective; but immunity tests with 0.5 cubic centimeter virus "T" given June 23 and July 5 failed to develop spotted fever.

Guinea pig No. 606, on which 7 ticks from goat No. 6 were placed June 15, showed no evidence of spotted fever, but was immune to 0.5 cubic centimeter virus "G" injected June 29.

The relative high percentage of infective ticks collected from goat No. 5 may be accounted for by its having acquired the majority of its 337 ticks from the same brood of infective ticks. There is no evidence to support the belief that the mountain goat can acquire or transmit Rocky Mountain spotted fever infection. Two guinea pigs (Nos. 580 and 581) were inoculated June 5 each with 1 cubic centimeter heart blood of goat No. 5 plus 2 cubic centimeters normal salt solution. One pig died a few hours after inoculation; the other was negative to the inoculation and positive to an immunity test given June 29.

Discovery of Immune Ground Squirrels (*C. columbianus*).

The susceptibility of certain wild mammals in the Bitter Root Valley to infection with spotted fever and the possibility of their acquiring immunity thereto having been proved, the importance of locating naturally infected animals among these species was pointed out by Ricketts,[1] and attention was redirected to the subject by McClintic[2] and Rucker.[3] Both emphasized the difficulties attending such a search, which are due mainly to the facts that the susceptible mammals (ground squirrels, wood chucks, rock squirrels, chipmunks, wood rats, weasels, and badgers) present no constant pathological change, symptomatology, nor temperature index which are certainly characteristic of spotted fever. For these reasons it is necessary to resort to indirect methods by inoculation into guinea pigs in order to determine whether the susceptible mammals have been infected with spotted fever.

In a report of the unfinished experiments of Dr. Ricketts on Rocky Mountain spotted fever by B. F. Davis [4] it is stated that the investigation of the presence of infected or immune animals in nature was outlined for the season of 1910, but unfortunately the experiments could not be carried out.

In 1911 McClintic and Rucker began a search for evidence of infection among the smaller mammals of the Bitter Root Valley (*a*) by furnishing their trappers with clinical thermometers and directing them to take the temperatures of all live animals captured, (*b*) by the inoculation of guinea pigs with blood from the freshly captured animals, and (*c*) by a study of the immunity of mammals captured in infected districts as determined by inoculating them with heart blood from infected guinea pigs and transferring after proper intervals into other susceptible guinea pigs.

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[1] Journ. A. M. A., 1907, vol. 49, p. 24.

[2] Public Health Reports, vol. 27, No. 20, May 17, 1912.

[3] Military Surgeon, vol. 29, No. 6, Dec., 1911.

[4] Contributions to Medical Science by Howard Taylor Ricketts, Univ. Chicago Press, p. 411.

The taking of temperatures was found inadequate for the reason given above and shortly abandoned.

During the season of 1911, blood from 21 ground squirrels captured west of Victor was injected into a corresponding number of guinea pigs with negative results. This method of search, because of its limitations, was then abandoned for the more complicated determination of the immunity of captured mammals to spotted-fever infection. The reason the first method was abandoned was the difference in the extent of the information conveyed by the two methods of experimentation. The first or direct inoculation into a guinea pig of blood taken from an animal at the time of its capture shows only the actual condition of the animal at the time of its capture, as to whether it then has or does not have spotted fever, while the information derived from the inoculation of susceptible wild animals and the later transfer of their blood to guinea pigs is much broader, covering at least many months of the life of the animal.

McClintic and Rucker began the search for immune animals among ground squirrels (*C. columbianus*) because of their great abundance and the suspicion which has been attached to them since Wilson and Chowning in 1902 suggested that they might be the animal host of the disease, and of the possibility of their being in some way intimately associated with the perpetuation of the Rocky Mountain spotted-fever virus. The method employed was described by McClintic as follows:[1]

"The ground squirrels were caught and kept in captivity until they had recovered from the injuries caused by the traps. They were then inoculated intraperitoneally with the virus of spotted fever" (0.5 to 1 cubic centimeter of fifth-day blood from an infected guinea pig in normal salt solution). "Their temperatures were taken each day, and at the end of definite periods inoculations of their blood" (0.5 to 2 cubic centimeters in salt solution) "were made intraperitoneally into guinea pigs." If this transfer, made on the fifth day, of blood from a previously inoculated ground squirrel produced spotted fever in the guinea pigs the squirrel clearly could not have been at that time immune to the disease, and it was therefore concluded that it had not been naturally infected for at least many months previous to the time of inoculation. On the other hand, if the transfer made on the fifth day was not followed by spotted fever in the guinea pig and the latter, when afterwards given the immunity test (0.5 cubic centimeter blood from a pig known to be infected with spotted fever), developed spotted fever, it was concluded that the ground squirrel, since incapable of transmitting the disease, was immune and therefore had been naturally infected.

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[1] Public Health Reports, vol. 27, No. 20, May 17, 1912.

In 1911 McClintic and Rucker experimented with 25 ground squirrels collected from districts supposed to have been badly infected with spotted fever and failed to find one immune squirrel among that number. In 1912 McClintic continued the search with a much greater number of ground squirrels, 194 in all, collected from different localities, and found 40 immune and therefore presumably previously infected ground squirrels, which had acquired their infection naturally either through bites of infective ticks or possibly by inheritance through a mother infected in this manner. Of the 194 ground squirrels which were trapped and used in these experiments, one group of 11 squirrels (Nos. 207 to 217, inclusive) caught on the forest reserve west of Victor, although noted by Dr. McClintic as "positive," were also recorded as "discarded." Apparently Dr. McClintic was not satisfied that the technique of this experiment had been above suspicion. For this reason these squirrels are not included in his final results. In two other groups of 11 squirrels each, one from Sweathouse Canyon and one from the river bottom east of Victor, the results of the transfers were not noted. These were the last squirrels experimented with, and it is probable that the transfers were never made.

The experiments and the results in the 161 ground squirrels as noted by Dr. McClintic are given below:

Ground squirrel.	Where collected.	Inoculated.	Transfer.	Result.	Remarks.
		0.5 c. c. "Old Virus."	0.5 c. c. Blood +2 c. c. Normal Salt Solution. *May 6.*		
71 F	Payne and Bates ranches, Apr. 10-12.	May 1, 1912	G. P. 428	+	G. P. 428 died May 20, spotted fever.
72 M	do	do	G. P. 429	+	G. P. 429 died May 14, spotted fever.
73 M	do	do	G. P. 430	+	G. P. 430 died May 12, accident.
74 M	do	do	G. P. 431	−	Immunity test May 20; 0.5 c. c. "Old virus," G. P. 431, positive.
75 M	do	do	G. P. 432	+	G. P. 432 died May 16, spotted fever.
76 M	do	do	G. P. 433	+	G. P. 433 died May 20, spotted fever.
77 F	do	do	G. P. 434	+	G. P. 434 died May 21, spotted fever.
78 M	do	do	G. P. 435	−	G. P. 435 immunity test May 20, 0.5 c. c. "Old virus," positive.
78 M	do	do	G. P. 462	−	Immunity test June 4, 0.5 c. c. "Old virus" G. P. 462, positive.
79 F	do	do	G. P. 436	+	G. P. 436 died Apr. 20, spotted fever
80 F	do	do	G. P. 437	+	G. P. 437 died Apr. 19, spotted fever.
81 F	do	do	G. P. 438	+	G. P. 438 killed for virus Apr. 11.
82 M	do	do	G. P. 439	+	G. P. 439 killed for virus Apr. 11.
83 M	do	do	G. P. 440	+	G. P. 440, spotted fever, recovered.
84 M	do	do	G. P. 441	+	G. P. 441 died Apr. 19, spotted fever.
85 M	do	do	G. P. 442	+	G. P. 442, spotted fever, recovered.
86	do	do	G. P. 443	+	G. P. 443 died Apr. 21, spotted fever.
87	do	do	G. P. 444	+	G. P. 444 died Apr. 21, spotted fever.

Ground squirrel.	Where collected.	Inoculated.	Transfer.	Result.	Remarks.
		0.5 C. C. VIRUS "T."	0.5 C. C. BLOOD +2 C. C. NORMAL SALT SOLUTION.		
			May 11.		
88 M	Payne and Williams ranches.	May 6, 1912	G. P. 449	+	G. P. 449, spotted fever, recovered.
89 M	do	do	G. P. 450	—	G. P. 450 immunity test May 29; killed for virus June 4.
90 F	do	do	G. P. 451	+	G. P. 451 died May 26, spotted fever.
91 M	do	do	G. P. 452	—	G. P. 452, immunity test May 29; killed for virus June 4.
92 F	do	do	G. P. 453	—	G. P. 453, immunity test June 17; killed for virus.
93 F	do	do	G. P. 454	+	G. P. 454 died May 19, spotted fever.
94 M	do	do	G. P. 455	—	G. P. 455, immunity test May 29; followed by spotted fever.
95 M	Bear Creek	do	G. P. 456	+	G. P. 456, spotted fever, recovery.
96 F	do	do	G. P. 457	+	G. P. 457 died May 19, spotted fever.
97 M	do	do	G. P. 458	+	G. P. 458 died May 26, spotted fever.
98 F	do	do	G. P. 459	+	G. P. 459 died May 18, spotted fever.
99 M	do	do	G. P. 460	—	G. P. 460, immunity test May 25, killed for virus.
100 F	do	do	G. P. 461	+	G. P. 461 died May 24, spotted fever.
		0.5 C. C. "OLD VIRUS."			
101 M	Foothills, Hamilton to Grantsdale.	May 12, 1912	G. P. 468	+	G. P. 468 died May 29, spotted fever.
102 M	do	do	G. P. 469	+	G. P. 469 died May 30, spotted fever.
103 M	do	do	G. P. 470	Void.	G. P. 470 died May 20, third day, greatly emaciated.
104 M	do	do	G. P. 471	+	G. P. 471 died May 30, spotted fever.
105 M	do	do	G. P. 472	+	G. P. 472 died May 23. Inoculation into G. P. 523 caused spotted fever.
106 M	do	do	G. P. 473	+	G. P. 473, spotted fever, recovery.
107 M	do	do	G. P. 474	+	G. P. 474, spotted fever, recovery. Killed because of inflammation of scrotum.
108 M	do	do	G. P. 475	+	G. P. 475 died May 27, spotted fever.
109 M	do	do	G. P. 476	+	G. P. 476 died May 28, spotted fever.
110 F	do	do	G. P. 477	+	G. P. 477 died May 30, spotted fever.
111 M	Florence school, sec. 16.	do	G. P. 478	+	G. P. 478, spotted fever, recovery.
112 F	do	do	G. P. 479	—	G. P. 479, immunity test June 17; followed by spotted fever.
113	Duffy ranch	do	G. P. 480	+	G. P. 480 died May 27, spotted fever.
114 M	Florence school, sec. 16.	do	G. P. 481	—	G. P. 481, immunity test June 4; followed by spotted fever.
115 F	do	do	G. P. 482	—	G. P. 482, immunity test June 4; followed by spotted fever.
116 M	do	do	G. P. 483	+	G. P. 483 died May 27, spotted fever.
117 M	do	do	G. P. 484	—	G. P. 484, immunity test June 4; followed by spotted fever.
			May 20.		
118 M	Florence school, sec. 16.	May 15, 1912	G. P. 490	—	G. P. 490, immunity test June 4; spotted fever.
119 F	do	do	G. P. 491	+	G. P. 491, spotted fever, recovery.
120 F	do	do	G. P. 492	—	G. P. 492, immunity test June 6; followed by spotted fever.
121 M	Foothills, Hamilton to Grantsdale.	do	G. P. 493	+	G. P. 493 died May 20, spotted fever.
122 M	do	do	G. P. 494	+	G. P. 494, spotted fever, recovery.
123 F	do	do	G. P. 495	+	G. P. 495 died May 20, spotted fever.
124 F	do	do	G. P. 496	—	G. P. 496, immunity test June 4; followed by spotted fever; died.
125 F	do	do	G. P. 497	+	G. P. 497 died June 1, spotted fever.
126 F	do	do	G. P. 498	+	G. P. 498, spotted fever, recovery.
127 M	do	do	G. P. 499	+	G. P. 499 died June 3, spotted fever.
128 F	Bear Creek	do	G. P. 500	+	G. P. 500, spotted fever, recovery.
129 F	do	do	G. P. 501	+	G. P. 501 died June 1, spotted fever.
130 F	do	do	G. P. 502	+	G. P. 502 died May 29, spotted fever.
131 F	do	do	G. P. 503	—	
132 F	do	do	G. P. 504	+	G. P. 504 died June 2, spotted fever.
133 F	do	do	G. P. 505	+	G. P. 505 died May 29, spotted fever.
134 F	do	do	G. P. 506	+	G. P. 506 died May 30, spotted fever

Ground squirrel.	Where collected.	Inoculated.	Transfer.	Result.	Remarks.
		0.5 C. C. "OLD VIRUS."	0.5 C. C. BLOOD +2 C. C. NORMAL SALT SOLUTION.		
			May 20—Con.		
135 M	Gash Creek and Hacketts.	May 12, 1912	G. P. 507	+	G. P. 507 died June 3, spotted fever.
136 M	do.	do.	G. P. 508	+	G. P. 508, spotted fever, recovery.
137 F	do.	do.	G. P. 509	+	G. P. 509 died May 30, spotted fever.
138 M	do.	do.	G. P. 510	+	G. P. 510 died June 5, spotted fever.
139 M	do.	do.	G. P. 511	—	G. P. 511, immunity test June 4; killed for virus.
			May 25.		
140 M	Darby, May 14	May 20, 1912	G. P. 529	+	G. P. 529 died June 3, spotted fever.
141 M	do.	do.	G. P. 530	+	G. P. 530 died June 9, spotted fever.
142 M	do.	do.	G. P. 531	+	G. P. 531 died June 14, spotted fever.
143 M	do.	do.	G. P. 532	+	G. P. 532, spotted fever, recovery.
144 M	do.	do.	G. P. 533	+	G. P. 533, spotted fever, recovery.
145 F	do.	do.	G. P. 534	+	G. P. 534, spotted fever, recovery.
146 F	do.	do.	G. P. 535	—	G. P. 535, immunity test June 7; followed by spotted fever.
147 F	do.	do.	G. P. 536	+	G. P. 536, spotted fever, recovery.
148 F	do.	do.	G. P. 537	+	G. P. 537, spotted fever, recovery.
			May 30.		
149 F	Landon Ranch, Stevensville.	May 25, 1912	G. P. 548	—	G. P. 548, immunity test June 23; followed by spotted fever.
150 M	do.	do.	G. P. 549	—	G. P. 549, immunity test June 14; followed by spotted fever.
151 F	do.	do.	G. P. 550	+	G. P. 550, spotted fever, recovery.
152 M	do.	do.	G. P. 551	+	G. P. 551, spotted fever, recovery.
153 M	do.	do.	G. P. 552	+	G. P. 552 died June 10, spotted fever.
			June 4.		
154 F	Williams Ranch.	May 30, 1912	G. P. 570	—	G. P. 570, immunity test June 17, negative; July 5, followed by spotted fever.
155 F	do.	do.	G. P. 571	+	G. P. 571, spotted fever, recovery.
156 F	do.	do.	G. P. 572	+	G. P. 572 died June 18, spotted fever.
157 M	do.	do.	G. P. 573	+	G. P. 573, spotted fever, recovery.
158 F	do.	do.	G. P. 574	+	G. P. 574 died June 10, spotted fever.
159 F	do.	do.	G. P. 575	—	G. P. 575, immunity test June 18; followed by spotted fever.
160 F	do.	do.	G. P. 576	—	G. P. 576, immunity test June 18, negative; July 5, negative.
161 F	do.	do.	G. P. 577	+	G. P. 577, spotted fever, recovery.
		1 C. C. VIRUS.	1 C. C. BLOOD +2 C. C. NORMAL SALT SOLUTION.		
			June 22.		
162 F	Foothills west of Hamilton.	June 17, 1912	G. P. 619	+	G. P. 619 died July 2, spotted fever.
163 F	do.	do.	G. P. 620	—	G. P. 620, immunity test July 10; killed for virus.
164 F	do.	do.	G. P. 621	+	G. P. 621, spotted fever, recovery.
165 F	do.	do.	G. P. 622	+	G. P. 622, spotted fever, recovery.
166 F	do.	do.	G. P. 623	+	G. P. 623, spotted fever, recovery.
167 F	do.	do.	G. P. 624	+	G. P. 624, spotted fever, recovery.
168 M	do.	do.	G. P. 625	+	G. P. 625 died July 2, spotted fever.
169 F	do.	do.	G. P. 626	—	G. P. 626, immunity test July 20; killed for virus.
170 F	do.	do.	G. P. 627	+	G. P. 627, spotted fever, recovery.
171 F	do.	do.	G. P. 628	+	G. P. 628 died July 7, spotted fever.
172 F	do.	do.	G. P. 629	+	G. P. 629 died July 4, spotted fever.
173 F	do.	do.	G. P. 630	+	G. P. 630, spotted fever, recovery.
			June 23.		
174 F	Mouth of Big Creek Canyon.	June 23, 1912	G. P. 645	+	G. P. 645 died July 10, spotted fever.
175 F	do.	do.	G. P. 646	+	G. P. 646 died July 11, spotted fever.
176 M	do.	do.	G. P. 647	+	G. P. 647 died July 7, spotted fever.
177 M	do.	do.	G. P. 648	+	G. P. 648 died July 11, spotted fever.

Ground squirrel.	Where collected.	Inoculated.	Transfer.	Result.	Remarks.
		1 C. C, VIRUS.	1 C. C. BLOOD + 2 C. C. NORMAL SALT SOLUTION.		
			June 23—Con.		
178 F	Mouth of Big Creek Canyon.	June 23, 1912	G. P. 649	+	G. P. 649, spotted fever, recovery.
179 M	do	do	G. P. 650	+	G. P. 650 died July 10, spotted fever.
180 M	Near Darby	do	G. P. 651	+	G. P. 651 died July 9, spotted fever.
181 M	do	do	G. P. 652	+	G. P. 652 died July 17, spotted fever.
182 F	do	do	G. P. 653	+	G. P. 653 died July 9, spotted fever.
183 F	do	do	G. P. 654	+	G. P. 654 died July 7, spotted fever.
184 F	do	do	G. P. 655	+	G. P. 655 died July 17, spotted fever.
185 F	do	do	G. P. 656	+	G. P. 656 died July 8, spotted fever.
186 F	do	do	G. P. 657	+	G. P. 657, spotted fever, recovery.
187 F	do	do	G. P. 658	+	G. P. 658, spotted fever, fecovery.
188 F	do	do	G. P. 659	+	G. P. 659, spotted fever, recovery.
			July 4.		
189 F	Anderson's Lo Lo.	June 29, 1912	G. P. 673	–	
190 F	do	do	G. P. 674	–	G. P. 674, immunity test July 15; killed for virus.
191 F	do	do	G. P. 675	+	G. P. 675 died July 17, spotted fever.
			July 15.		
192 M	Anderson's Lo Lo.	July 10, 1912	G. P. 680	–	
193 F	do	do	G. P. 681	–	
194 F	do	do	G. P. 682	–	
195 F	do	do	G. P. 683	+	G. P. 683 died July 27, spotted fever.
196 F	do	do	G. P. 684	+	G. P. 684 died July 28, spotted fever.
197 F	do	do	G. P. 685	+	
198 M	do	do	G. P. 686	–	
199 M	do	do	G. P. 687	+	
200 M	do	do	G. P. 688	+	
201 M	do	do	G. P. 689	–	
202 F	do	do	G. P. 690	+	
203 M	do	do	G. P. 691	–	
204 M	do	do	G. P. 692	+	G. P. 692 died Aug. 1, spotted fever.
205 F	do	do	G. P. 693	+	G. P. 693 died Aug. 1, spotted fever.
206 F	do	do	G. P. 694	+	
218 F	West of vat, Florence.	do	G. P. 706	+	
			July 20.		
219 F	West of vat, Florence.	July 15, 1912	G. P. 728	–	
220 M	do	do	G. P. 729	–	
221 M	do	do	G. P. 730	+	
222 M	do	do	G. P. 731	+	
223 M	Lo Lo	do	G. P. 732	–	
224 M	do	do	G. P. 733	+	G. P. 733 died July 31, spotted fever.
225 M	do	do	G. P. 734	+	
226 F	do	do	G. P. 735	–	
227 M	do	do	G. P. 736	+	G. P. 736 died July 28, spotted fever.
228 F	do	do	G. P. 737	+	G. P. 737 died July 30, spotted fever.
			July 25.		
229 M	Lo Lo	July 20, 1912	G. P. 747	+	
230 M	do	do	G. P. 748	–	
231 M	do	do	G. P. 749	–	
232 F	do	do	G. P. 750	+	
233 F	do	do	G. P. 751	+	
234 M	do	do	G. P. 752	+	
235 F	West of Florence vat.	do	G. P. 753	+	
236 M	do	do	G. P. 754	–	
237 M	do	do	G. P. 755	+	
238 M	do	do	G. P. 756	+	
239 M	do	do	G. P. 757	–	
240	do	do	G. P. 758	+	
241 M	do	do	G. P. 759	+	
242 F	do	do	G. P. 760	+	

REINOCULATIONS AND TRANSFERS.

Ground squirrel.	Previous transfer.	Reinoculation.	Transfer.	Result.	Remarks.
75 M	May 6 to G. P. 432 +	1912 May 30	June 4 to G. P. 564	–	G. P. 564 immunity test June 22, followed by spotted fever, recovery.
81 F	May 6 to G. P. 438 +	...do...	June 4 to G. P. 565	–	G. P. 565 immunity test July 10, killed for virus.
92 F	May 11 to G. P. 453 +	...do...	June 4 to G. P. 566	–	G. P. 566 immunity test June 22, followed by spotted fever, recovery.
99 M	May 11 to G. P. 460 –	...do...	June 4 to G. P. 567	+	G. P. 567, spotted fever, recovery.
120 F	May 20 to G. P. 492 –	...do...	June 4 to G. P. 568	–	G. P. 568, immunity test June 22, followed by spotted fever, recovery.
139 M	May 20 to G. P. 511 –	...do...	June 4 to G. P. 569	–	G. P. 569, immunity test June 22, followed by spotted fever, recovery.
146 M	May 25 to G. P. 535 –	June 17	June 22 to G. P. 631	–	
150 M	May 30 to G. P. 549 –	June 27	June 22 to G. P. 632	–	G. P. 632, immunity test July 15, killed for virus.

The experiment with ground squirrel 103 was noted as "void," guinea pig 470 which was inoculated from the squirrel having died on the third day. There remain, then, 160 ground squirrels, among which 40 were found incapable of transmitting spotted fever to guinea pigs by means of blood inoculations taken on the fifth day after injection of a known spotted-fever virus.

Grouping of the ground squirrels according to the localities from which they were collected is of interest in that it shows a higher percentage of immune squirrels from those localities believed to contain the greatest amount of spotted-fever infection.

Localities.	Positive susceptible.	Negative immune.	Total.
Victor:			
Payne and Bates ranch	9	6	15
Bear Creek	20	2	22
Williams ranch	5	3	8
Gash Creek and Hacketts	4	1	5
Big Creek	6	0	6
Foothills:			
Hamilton and Grantsdale	25	3	28
Darby	17	1	18
Stevensville	3	2	5
West of vat:			
Florence	13	10	23
Lo Lo	18	12	30
Total	120	40	160

As noted above, 8 ground squirrels (3 formerly positive and 5 negative) were reinoculated and transfers again made in from three to six weeks following the first experiment.

The three squirrels which had previously given positive transfers, after the reinoculation, were negative, showing that they had acquired an immunity from the first inoculation. Of the five ground squirrels which failed to transfer the spotted-fever infection in the first instance, four continued immune, while No. 99 did transmit the virus to guinea pig 567. We can only conclude either that there was some fault in the technique of the first experiment or that the ground squirrel lost its immunity sometime between May 11 and June 4.

In these experiments Dr. McClintic, for the first time, definitely established the existence of immune, and therefore presumably naturally infected, ground squirrels on the west side of the Bitter Root Valley. He also discovered a difference in the percentage of immune squirrels from different localities which appears to bear a close relation to the degree of Rocky Mountain spotted fever believed to exist in those localities.

It is unfortunate that the results obtained with his control experiments on ground squirrels collected from the river bottom east of Victor and from high up in the Bitter Root were not completed. This will be done during the ensuing season.

Susceptibility and Immunity Experiments with Woodchucks (Marmota flaviventer).

Ricketts found that woodchucks were susceptible to infection with Rocky Mountain spotted fever, both by inoculation and through the bites of infective ticks.[1]

During 1912 McClintic conducted a series of experiments with 15 woodchucks similar to those performed with ground squirrels as reported above. The woodchucks were inoculated with a known spotted-fever virus and transfers of heart blood were made from them after definite intervals into susceptible guinea pigs. These experiments, and the results obtained, were noted as follows by Dr. McClintic:

Woodchuck No.	Transfers to—	Result.	Remarks.
1	G. P. 543, May 28, 2 c. c. blood	−	Immunity test June 7, followed by spotted fever.
1	G. P. 544, May 28, 0.5 c. c. blood	−	Do.
2	G. P. 553, May 30, 0.5 c. c. blood, fifth day	−	Do.
2	G. P. 554, May 30, 0.5 c. c. blood, fifth day	+	Immunity test June 23, negative.
2	G. P. 560, June 2, 0.5 c. c. blood, eighth day	−	Immunity test June 22, followed by spotted fever.
2	G. P. 561, June 2, 0.5 c.c. blood, eighth day	+	G. P. 561, spotted fever, died June 15.
3	G. P. 562, June 3, 0.75 c.c. blood, fourth day	−	Immunity test June 22, followed by spotted fever.
3	G. P. 563, June 3, 2 c. c. blood, fourth day	+	Spotted fever, recovery.
3	G. P. 589, June 7, 1 c. c. blood, eighth day	−	G. P. 589 later had spotted fever.
4	G. P. 611, June 22, 0.75 c. c. blood, fifth day	+	Spotted fever, recovery.
5	G. P. 614, June 22, 1.25 c. c. blood, fifth day	+	Do.
5	G. P. 662, June 29, 1 c. c. blood, twelfth day	−	
6	G. P. 615, June 22, 1.25 c. c. blood, fifth day	+	Do.
6	G. P. 616, June 22, 1.25 c. c. blood, fifth day	+	Do.
6	G. P. 663, June 29, 1 c. c. blood, twelfth day	−	Immunity test July 15, followed by spotted fever.
7	G. P. 617, June 22, 0.75 c. c. blood, fifth day	+	G. P. 617 died of spotted fever June 24.
7	G. P. 618, June 22, 1.25 c. c. blood, fifth day	+	Spotted fever, recovery.
7	G. P. 664, June 29, 1 c. c. blood, twelfth day	+	G. P. 664 died of spotted fever July 12.
7	G. P. 669, July 4, 1 c. c. blood, seventeenth day.	−	Immunity test July 15, followed by spotted fever.

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[1] Med. Record, 1909, vol. 76, p. 842.

Woodchuck No.	Transfers to—	Result.	Remarks.
8	G. P. 663, June 24, 1 c. c. blood, fifth day.....	+	G. P. 633 died of spotted fever July 1.
9	G. P. 634, June 24, 0. 1 c.c. blood, fifth day...	+	Spotted fever, recovery.
9	G. P. 641, June 27, 1 c. c. blood, eighth day..	+	G. P. 641 died of spotted fever July 17.
10	G. P. 635, June 24, 0.75 c. c. blood, fifth day..	−	Later had spotted fever.
10	G. P. 636, June 24, 1.25 c. c. blood, fifth day..	−	Immunity test July 5, followed by spotted fever.
10	G. P. 642, June 27, 1 c. c. blood, eighth day..	−	
11	G. P. 637, June 24, 0.75 c. c. blood, fifth day.	−	
11	G. P. 638, June 24, 1.25 c. c. blood, fifth day.	−	Immunity test July 10, followed by spotted fever.
11	G. P. 643, June 27, 1 c. c. blood, eighth day..	−	Immunity test July 23, followed by typhus fever.
12	G. P. 639, June 24, 1 c. c. blood, fifth day...	+	Spotted fever, recovery.
12	G. P. 644, June 24, 1 c. c. blood, eighth day.	+	G. P. 644 died of spotted fever July 7.
12	G. P. 667, July 3, 1 c. c. blood, fourteenth day.	+	G. P. 667 died of spotted fever July 17.
13	G. P. 660, June 28, 0.75 c. c. blood, fifth day.	+	Spotted fever, recovery.
13	G. P. 661, June 28, 1.25 c. c. blood, fifth day..	+	Do.
13	G. P. 671, July 4, 1 c. c. blood, fifth day.....	+	Do.
14	G. P. 672, July 4, 1 c. c. blood, fifth day.....	+	Spotted fever; killed for virus.
15	G. P. 708, July 15, 1 c. c. blood, fifth day....	+	G. P. 708 died of spotted fever July 28.

Of the 15 woodchucks injected with spotted-fever virus in this series of experiments, 11 were shown to be susceptible to infection with the virus, while 3 animals—Nos. 1, 10, and 11—were not infected in this manner. These 3 animals may have derived their immunity from a previous infection acquired in nature through the bites of infective ticks.

It is noticeable that woodchucks Nos. 2 and 3 did not transmit the infection to all the guinea pigs injected from them.

Woodchucks Nos. 5, 6, and 7, while positive on the fifth day following inoculation, were negative on the twelfth day, while woodchuck No. 12 retained its infectivity up to the fourteenth day. This seems to indicate that a tick attaching itself to this woodchuck any time within a period of 11 days would have become infected.

In a series of experiments with rock squirrels (*Callospermophilus lateralis cinerascens*) Dr. McClintic injected 11 of these animals with Rocky Mountain spotted fever virus. Four were noted as having transmitted the infection to guinea pigs by the inoculation of 0.75 cubic centimeter of heart blood on the fifth day, and the remaining experiments were not completed.